Integrated Water Quality and Aquatic Communities Protocol – Wadeable Streams

Standard Operating Procedure (SOP) #4: Data Entry

Draft Version 1.0

Revision History Log:

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

This SOP provides the details on collecting data using a tablet computer along with a Microsoft Access database or by using hardcopy datasheets. This SOP only details the preparation, usage, storage, and care of the tablet computer, plus how to enter data into the database in the event that paper datasheets (Appendix F) must be utilized. Information on how the measurements are made is covered in the appropriate SOPs. In the case of a tablet PC not functioning, the recording procedure on datasheets is identical to the tablet PC data form, albeit manually done on weather-proof paper, clipboard, and pencil.

Field Work Preparations

Prior to starting the field work, the Data Manager is responsible for setting up the tablet computer. The Field Crew Leader should double check this equipment prior to going into the field to make certain it is set up and functioning properly. The Project Lead is responsible for making certain the field crew has been properly trained on how to use all of the data collections equipment as described in SOP #2: Field Crew Training. In the near future, the KLMN will use a Trimble YUMA rugged tablet computer to collect data. This model is lightweight and can withstand the environmental conditions associated with monitoring streams in the park units that comprise the Klamath Network. In the event of a change in either (1) the tablet computer or (2) the access database, this SOP will be revised and updated as necessary.

Equipment

When preparing to go into the field, one member of each crew should check out the following equipment, which should already be set up by the Data Manager.
- 1 Tablet computer
- 1 Tablet computer power cord
- 1 Vehicle adapter for power cord
- 2 Eight gigabyte (or greater) flash drives
- 1 Cleaning cloth
- 2 Spare batteries (the tablet computer operates on two)

- 3 Stylus
- 1 Power inverter

It is the responsibility of the field crew who checks out the equipment to make certain everything is charged and working properly. It is also the responsibility of the field crew who checks out the equipment to make certain it is treated properly while conducting field work. The tablet computer represents a substantial monetary investment and should be treated as such.

Tablet Computer
For the near future, the KLMN will use a Trimble YUMA rugged tablet computer to collect data (Figure 1). Complete operating procedures, usage, and specifications can be found in Appendix P.

Figure 1. YUMA tablet computer used to store stream monitoring data while in the field.

Charging Equipment
Before heading into the field, make certain the tablet computer and spare batteries are charged. This equipment should be plugged in when not in use, either to a wall socket or to the power inverter in the field vehicle. Please note the tablet computer is set up to be energy efficient. Do not change this setting without checking with the Data Manager.

Project Folder
Turn on the tablet computer by pressing the green button on the left side of the screen. Using the stylus, tap on the Crew Member user icon. A shortcut to the Stream Project Folder should be located on the desktop; double tap on the icon and you should see the folder structure shown in Figure 2.
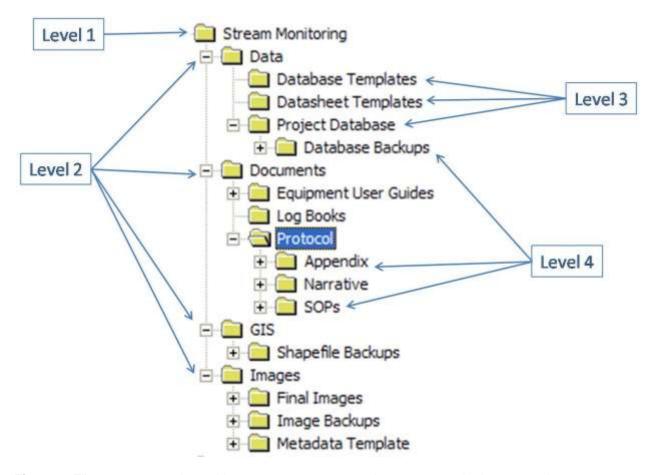
Figure 2. File structure used on tablet computers to support the stream monitoring protocol.

This folder structure is located on the C:\ drive of the tablet computer. The core of this filing structure (Levels 1 and 2) mimics the file structure of all KLMN project folders located on the KLMN office server and on the flash drive for project data backup. The third and fourth level of the folder structure has standardized folders, which are described below but may also contain additional folders that are project-specific. Field crew members and project managers can add information to these folders as necessary; however, folder names should only be altered with the permission of the Data Manager. Standard third level folders include the following:

Data Folder
- Database Template – This folder contains a blank (no existing data) project database that can be copied and used in the event something happens to the project database.
- Datasheet Template – This folder contain a copy of the datasheets.
- Project Database – This is the database that is used to store the project data while in the field.

Documents Folder
- Equipment Documentation – This folder contains documents pertaining to equipment used for this project. This can include user guiders, technical guides, etc.
- Log Books – Log books are forms used to document specific items for QA/QC purposes. This folder contains the five log books used in this project including the Training (SOP

#2), Event (SOP #18), Datasheet (SOP #18), Calibration (SOP #7) and Equipment (SOP #18) logs.

- Protocol – Contains a copy of this protocol.

GIS Folder

- Shapefile Backups – This folder contains a backup copy of all shapefiles used on any Trimble or Garmin GPS units.

Images Folder

- Final Images – At the end of the field season, the final images are placed in this folder along with photograph metadata (e.g., description, date, location, etc.).
- Image Backup – Backup copies of images are placed in this folder to ensure they are not lost if damage occurs to the camera.
- Metadata Template – This is a template of the required metadata for each picture taken while working on a KLMN project. These data can also be entered directly into the database (SOP #16).

Utilizing the Project Database

1. Double tab on the "Stream Monitoring" icon on the desktop of the tablet computer.
2. Go to: Stream Monitoring→Data→Project Database
3. Double click on: Stream_FE_ProjectDatabase_v1.0.MDB
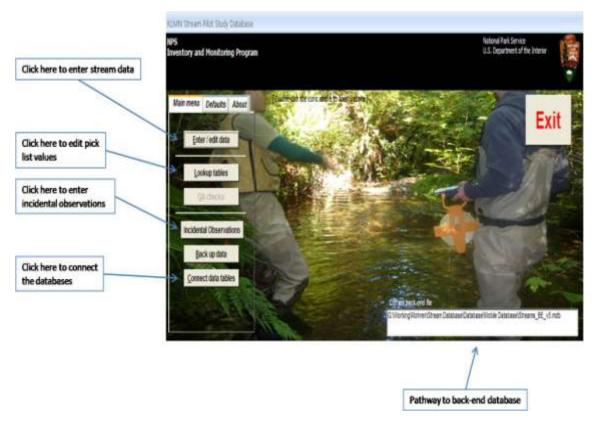4. The project database should open and you should see a screen (Figure 3).

Figure 3. The starting switchboard for the stream monitoring database.

Linking the Database

The stream monitoring database used for this project relies on a back-end/front-end structure to store and maintain data. The back-end database contains the tables and associated data while the front-end database contains the forms and queries used in this database system. In most cases, the databases should be linked when you click on the Stream_FE_ProjectDatabase.mdb file. On the bottom right corner of the main page of the database, you should see the pathway to the back-end database. Make certain this is correct before entering data. This path should read: C:\Stream Monitoring\Stream Data\Database\Stream_FE_ProjectDatabase v1.0.mdb

If the pathway is incorrect or you get a linking error when you open the database, follow the steps listed below:
1. From the main menu, click the "Connect data tables" command button.
2. Click the browse button and go to the back-end database following the pathway listed above.
3. Click "Open."
4. Click "Update Links."
5. You should now be linked to the proper database.

Data Entry

Once you are ready to collect data, turn on the tablet computer. Log in as "Field Crew" and open the database as described above. If you are collecting an incidental observation, click the "Incidental Observation" button and go the "Incidental Observation" section of this SOP. If you are collecting stream monitoring plot data, click the "Enter / Edit Data" button and go to the "Stream Data Collection" section of this SOP.

If data are being transferred from paper datasheets into electronic format, either onto a tablet computer or desktop (and laptop) computer, the methods are the same, except that a mouse can be used instead of tapping with a stylus.

Stream Data Collection
1. Click on the "Enter / Edit Data" button (Figure 3).
2. Using the drop down list in the "User" field, select your name. If your name is not in the list, click the "New User" button and populate **ALL** the information and then tap "Close." Make certain the additional fields on the "Set application default values" form match the list below.
   a. Park = The park where you are working
   b. Datum = Datum you are using to collect data (NAD83 is the KLMN standard)
   c. UTM Zone = 10N
   d. Protocol = Stream Protocol v1.0 (or latest version of the stream protocol)
   e. Project = KLMN Stream Monitoring
3. Once these fields are properly populated, click "OK."
4. You may or may not see a list of all the records that have already been entered. Do not alter these records unless you are doing an edit.
   - If you are entering data for a site that has not been visited that year, go to step 5.
   - If you are editing data from a previous visit, in the filter box enter the park that has the data you want to edit (Figure 4). Find the record you want to edit and

double click on the "Visit Date" field. Make any necessary edits if you are editing or go to step 11 if you are continuing data entry from a previous day.

5. If you are entering data from a new visit (the most common reason), at the top of the screen, tap the "Add a New Record" button.
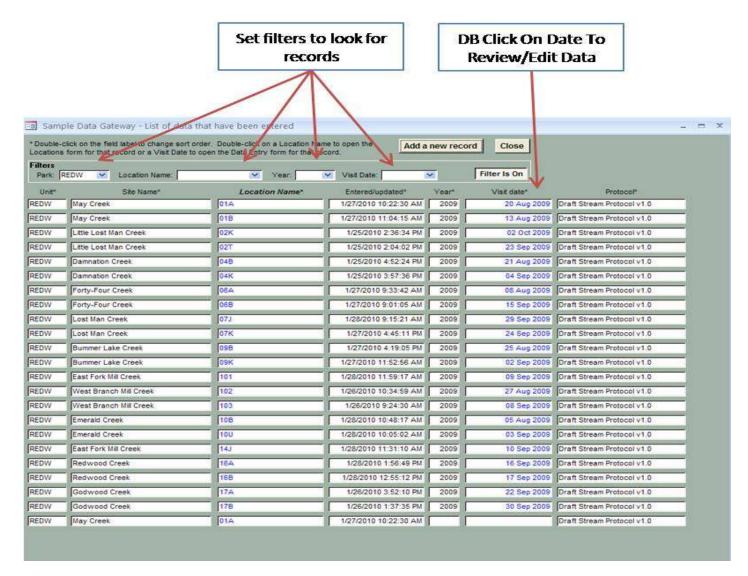
Figure 4 Sample Data Gateway. Double Click (DB click) on visit date to edit, or "Add a new record" to start a new site.

6. In the top header (Figure 5), use the drop down list in the "Location" field and select the name of your site. Continue on to step 7, even if the name is not in the list.
7. Next to the "Location" field, click the "Edit" button if the location was in the list or click the "Add New" button if the site was not listed.
8. Complete all the fields on this form as thoroughly as possible.
    a. **NPS Unit**: Park unit where the data is being collected
    b. **Stream:** The name of the stream you are working on. If the stream name is not in the picklist, click the "Add New Stream" button and add it to the list.
    c. **QA/QC:** This field is completed once all the data are entered and someone has reviewed the form. Select the name of the person who reviewed this form.
    d. **Site ID:** A unique number/letter combination used to name the point marking transect F for each reach surveyed.
    e. **Stream / River Verified by:** Check each method used to verify that you were at the right location. If "other" is checked, describe what the other method was in the appropriate box.
    f. **GPS Unit:** Select unit type used to find or confirm the site location.
    g. Depending on the type of GPS unit used, enter the **epe error** (Estimated position error) for a Garmin unit (e.g., +/-3 feet) or **PDOP** (Positional Dilution of Precision) for a Trimble unit (e.g., PDOP 3).
    h. Enter the **Latitude** and **Longitude**, being sure to include the negative sign in the longitude field.
    i. Enter **Coordinate Units, Zone, System, and Datum** used to collect the data.
    j. If you sampled this site, click the checkbox marked "**Check if you sampled the site**."
    k. If you checked the box in step J, select a "**Sampleable**" method. If you did not check the box, select a "**Non-Sampleable"** method
    l. If there are any general comments about the site, describe them in the **comment** box. Such comments could include issues with the location of the site, difficulties monitoring the site, etc. Comments should be written in complete sentences and sentence case so they can be used in future report summaries.
    m. **Drive Time**: Enter the amount of time it took to drive to the site. Time should be in minutes.
    n. **Hike Time**: Enter the time it takes to hike from the parking/camping site to the stream site. Time should be entered in minutes.
    o. **Directions to site**: Using sentence case and complete sentences, enter the directions to the site and include access issues.
9. Once all the fields have been completed, tab the "Close" button.
10. Using the dropdown menu, select the name of the location. Once selected, the X/Y coordinates and Unit code should automatically populate.
11. Using the drop down menu, select the name of the protocol you are using.
12. Enter the "Start Date" in the format mm/dd/yyyy.
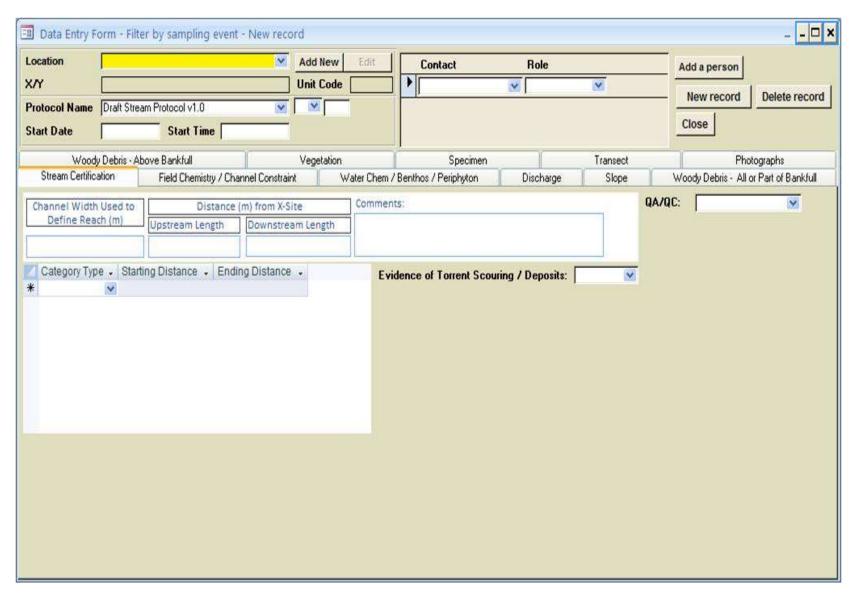13. Enter the "Start Time" in the format hh:mm.

Figure 5. Data entry screen showing location header (top) and Stream Certification tab (bottom)

If you examine the lower part of this form, you will see that there are 11 data tabs that need to be completed before leaving the site. Information on how to collect the data is located in the respective SOP for each set of parameters.
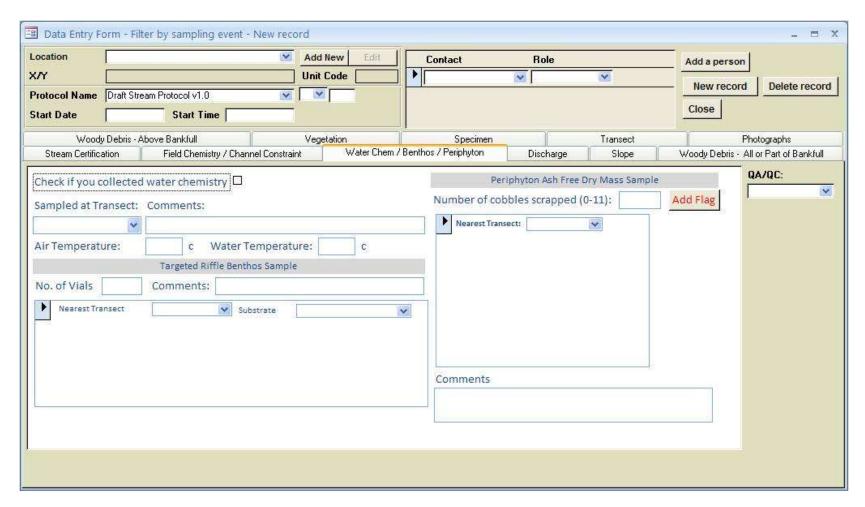
14. In the stream certification tab (Figure 5), complete the following fields:
    a. **Channel Width Used To Define Reach:** This is the width that was used to calculate the upstream and downstream lengths.
    b. **Upstream Length:** The length used to layout the upstream transects.
    c. **Downstream Length:** The length used to layout the downstream transects.
    d. **Comments:** General comments about the stream length calculation.
    e. **Category Type**: Select Pool, Riffle, or Run and enter the starting and ending distance. Complete this for each pool, riffle, or run in the reach.
    f. **Starting Distance**: Enter the distance at which the category type starts, in meters.
    g. **Ending Distance**: Enter the distance at which the category type ends, in meters.
    h. Repeat steps E-G until all category types and associated distances have been entered.
    i. **Evidence of Torrent Scouring / Deposits:** Select one of the following:
       01- Stream channel has a recently de-vegetated corridor two or more times the width of the low flow channel. This corridor lacks riparian vegetation with the possible exception of fireweed, even-aged alder or cottonwood seedlings, grasses, or other herbaceous plants.
       02- Stream substrate cobbles or large gravel particles are NOT IMBRICATED (meaning that they do not lie with the flat sides horizontal, like roof shingles) Stones laying unorganized, lying "every which way." Substrate may be angular (not water-worn).
       03- Channel has little evidence of pool-riffle structure. (Could you ride a mountain bike down the stream?)
       04- The stream channel is scoured down to bedrock.
       05- There are gravel or cobble berms (levees) above bankfull height.
       06- Downstream of the scoured reach, there are massive deposits of sediment, logs, or other debris.
       07- Riparian trees have fresh bark scars at main points, at very high levels above the channel bed.
       08- Riparian trees have fallen into the channel as a result of scouring near their roots.
       09- There are massive deposits of sediment, logs, and other debris in the reach. They may contain wood and boulders that, in your judgment, could not have been moved even at extreme flood stage.
       10- If the stream has begun to erode newly laid deposits, it is evident that these deposits are "matrix supported" (meaning that large particles are not necessarily touching but have silt and sand in between them and these fine materials support the larger particles).
       11- No evidence of torrent scouring or torrent deposits.
    j. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.

Figure 6. Data entry screen for Field Chemistry/Channel Constraint form.

15. At the top right side of the screen, use the picklist to enter the names of the crew members and their roles in sampling for that site. Names are entered multiple times if they have completed multiple roles.
16. Click on the Field Chemistry / Channel Constraint tab (Figure 6) and enter the following fields (for descriptions of a. – l., see SOPs #7 and #8):
    a. pH Standard.
    b. pH Check Reading.
    c. pH Recalibrated? Membrane Replaced?
    d. Cond. Standard.
    e. Cond. Check Reading.
    f. Cond. Recalibrated? Membrane Replaced?
    g. DO Sat. Standard.
    h. DO Sat. Check Reading.
    i. DO Sat. Recalibrated? Membrane Replaced?
    j. Water Volume Sample 1, 2, and 3.
    k. Titrant Strength Sample 1, 2, and 3.
    l. Reading Sample 1, 2, and 3.
    m. Use the picklist to select a "**Channel Pattern**."
       (a) *One Channel* – One channel.
       (b) *Braided Channel* **–** Multiple short channels branching and rejoining, mainly one channel broken up by numerous mid-channel bars.
       (c) *Anastomosing* **–** Relatively long major and minor channels branching and rejoining.
    n. Use the picklist to select a "**Channel Constraint**."
       (a) *Constrained In V-Shaped Valley* – Channel very constrained in V-Shaped valley (i.e., it is very unlikely to spread out or erode a new channel during a flood).
       (b) *Broad Valley* – Channel is in Broad Valley but channel movement by erosion during floods is constrained by Incision.
       (c) *Narrow Valley* – Channel is in Narrow Valley, not very constrained but limited in movement by relatively narrow adjacent hillslopes.
       (d) *Unconstrained in Broad Valley* – Channel is Unconstrained in Broad Valley (i.e., during flood it can fill off-channel areas and side channels, spread out over flood plain, or easily cut new channels by erosion).
    o. Use the picklist to select a "**Channel Feature**."
       (a) Bedrock.
       (b) Hillslope.
       (c) Terrace.
       (d) Human Bank Alterations.
       (e) No Constraining Features.
    p. Enter the **% of channel length with margin in contact with constraining features**.
    q. Enter the "**Bankfull Width**" in meters.
    r. Enter the "**Valley Width**" in meters.
    s. If you are not able to see the valley border, **check the appropriate box**.

t. Enter any **general comments** about the field chemistry or channel constraint measurements.

u. **QA/QC**: Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.

17. Click on the Water Chem / Benthos / Periphyton tab (Figure 7) and enter the following fields:

a. Check the appropriate box if you **collected water chemistry**.

b. Use the picklist to select the **transect** where the water chemistry sample was taken.

c. Enter any **comments** about the water chemistry sample.

d. Enter the **Air and Water temperature** in degrees Celsius.

e. Enter the **number of vials** used for the benthos sample.

f. Enter any **general comments** about the benthos sample.

g. Using the picklist, select the nearest transect and substrate type for each of the benthos samples. Repeat this step until all samples have been entered.

h. Enter the **number of cobble scraped** for the periphyton ash sample.

i. Enter the **nearest transect** for each sample. Continue until the nearest transect for each sample has been entered.

j. Enter any **general comments** about the periphyton sample.

k. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.

18. Click on the Discharge tab (Figure 8) and enter the following fields:

a. Enter the **stream width at the point of the discharge** calculation in meters.

b. Select the **nearest transect to the point of discharge** using the picklist.

c. Enter the **model and KLMN number** of the discharge meter used.

d. Select the **distance, depth, and velocity units** used to measure the discharge.

e. For each point, enter the **point number, distance from the bank, depth, and velocity**. Repeat until all values have been entered.

f. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.

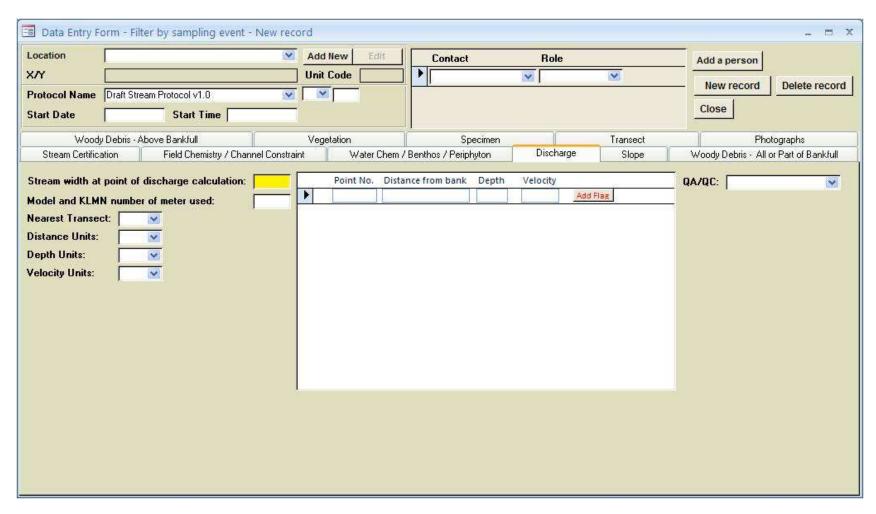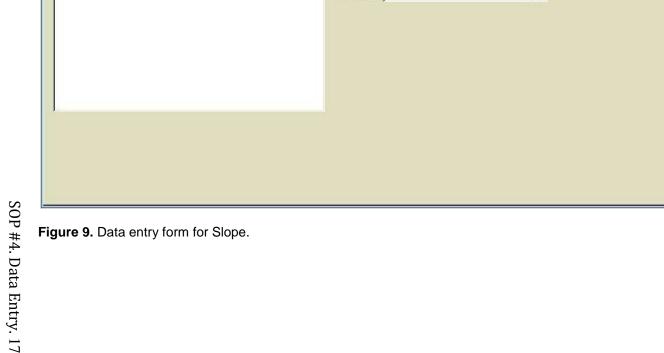**Figure 7.** Data entry form for Water Chem/Benthos/Periphyton tab.

Figure 8. Data entry form for Discharge tab.

19. Click on the Slope tab (Figure 9) and enter the following fields:
    a. For the distance between each **transect**, enter an **upper and lower reading** for the slope in percent.
    b. Enter any **general comments** about the slope reading.
    c. **QA/QC**: Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
20. Click on the Woody Debris – Above Bankfull tab (Figure 10). This tab is broken down into several components. There are three length classes: 1.5-5 meters, 5-15 meters, and >15 meters and within each length class there are five diameter classes: 0.1-0.3 meters, 0.31-0.6 meters, 0.61 to 0.8 meters, 0.8 to 2.0 meters, and >2.0 meters. Each time you encounter woody debris, click the "+" sign under the appropriate class.
    a. If you click the + sign accidentally, you can tap in the field and use the virtual keyboard to enter the appropriate number.
    b. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
21. Click on the Woody Debris – All or Part of Bankfull tab (Figure 11). This tab is broken down into several components. There are three length classes: 1.5-5 meters, 5-15 meters, and >15 meters and within each length class there are five diameter classes: 0.1-0.3 meters, 0.31-0.6 meters, 0.61 to 0.8 meters, 0.8 to 2.0 meters, and >2.0 meters. Each time you encounter woody debris, click the "+" sign under the appropriate class.
    a. If you click the + sign accidentally, you can tap in the field and use the virtual keyboard to enter the appropriate number.
    b. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
    c. With the two forms of woody debris, the crew will have to alternate forms, as transects are accomplished one by one. Special care must be taken that the crew is entering the data on the correct form.
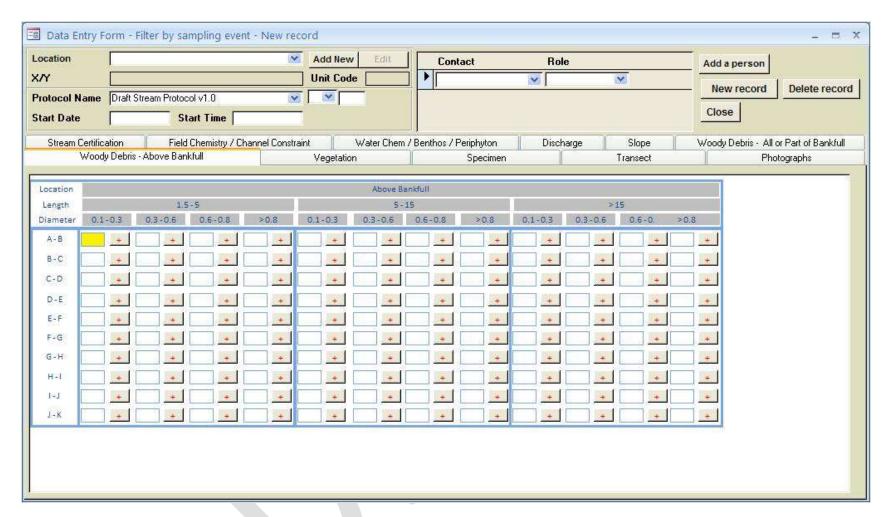
Figure 9. Data entry form for Slope.

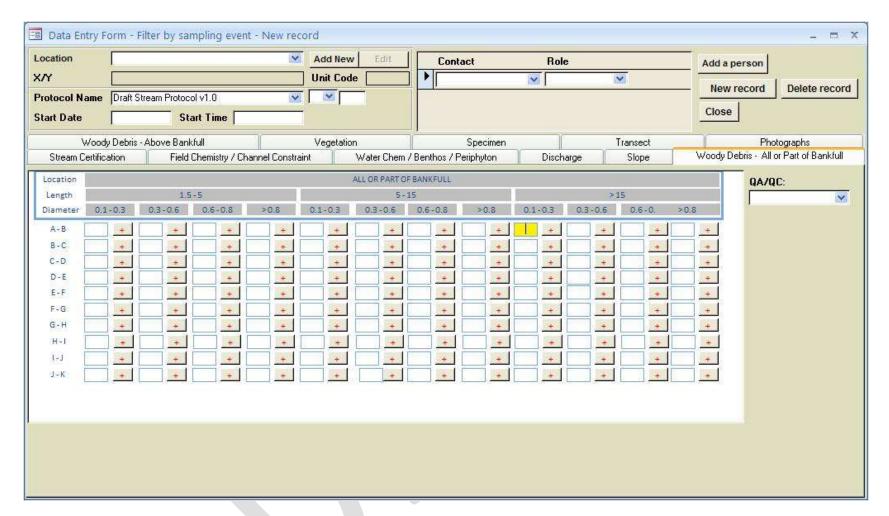**Figure 10.** Data entry form for Woody Debris – Above Bankfull.

Figure 11. Data Entry form for Woody Debris – All or part of Bankfull.

22. Click on the Vegetation tab (Figure 12) and enter the following fields for each transect:
   a. **Transect** – Use the picklist to select the transect letter.
   b. Check the box marked "**Check if tree is not visible**" if you cannot see the tree.
   c. Use the picklist to select the **DBH** category of the tree on the right and left. There are five possible choices.
      (i) 0.0 – 0.1
      (ii) 0.1 – 0.3
      (iii) 0.3 – 0.6
      (iv) 0.6 – 0.8
      (v) 0.8 – 2.0
      (vi) >2.0
   d. Enter the **Height** of the tree in meters for the right and left tree.
   e. Enter the **distance** of the tree to the stream in meters for the right and left tree.
   f. Enter the broad **category type** for the right and left tree.
      (a) Deciduous
      (b) Conifer
      (c) Broadleaf Evergreen
   g. Select the **taxonomic category** for the right and left tree. If you are able to identify the specific tree species, enter it instead of one of the selected classes.
   h. **Check the boxes for all invasive plants that are present**. If no plants are present, check **NONE**.
   i. Repeat steps A-H for each transect surveyed.
   j. Enter any general comments about the vegetation data collection.
   k. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
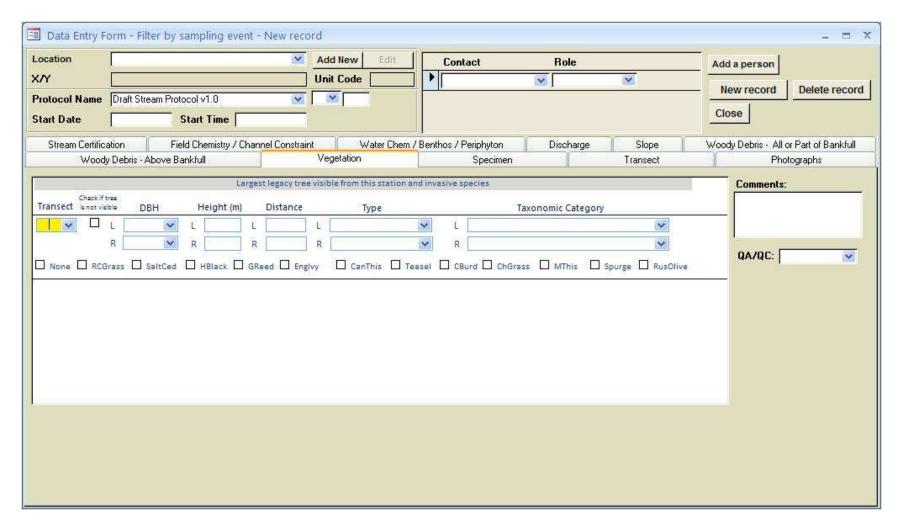
Figure 12. Data entry form for Vegetation.

23. Click on the Specimen tab (Figure 13) and enter the following fields:
   a. If **snorkeling, seine netting, or electrofishing** was implemented, check the appropriate boxes.
   b. If electrofishing was checked, enter the **wave form, volts, watts, pulse rate, amps, pulse width, total shock time, total fishing time, and sampling distance**. Use picklist when appropriate.
   c. If the site was **not fished or if no fish** were collected, check the appropriate boxes.
   d. Select the **visibility of the water** using the picklist. There are two possible options:
      (i) Good
      (ii) Poor
   e. For each **amphibian or fish species observed/collected**, enter the following information:
      (i) **Species number** – Chronological count of the individuals observed.
      (ii) **Common name** of the species.
      (iii) **Total number** of species observed – Number of species observed in one location.
      (iv) **Minimum length** in mm – If more than one individual was found, provide the length of the smallest individual.
      (v) **Maximum length** in mm – If more than one individual was found, provide the length of the largest individual.
      (vi) **Anomaly count** – Number of individuals with an anomaly.
      (vii) **Mortality count** – Number of individuals found dead.
      (viii) Check the **transect** where the species was observed.
   f. Repeat step E for each observation.
   g. If you need to **flag the observation**, follow step E. Once complete, click the "Add Flag" button and enter the flag number and the comment.
   h. **QA/QC:** Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
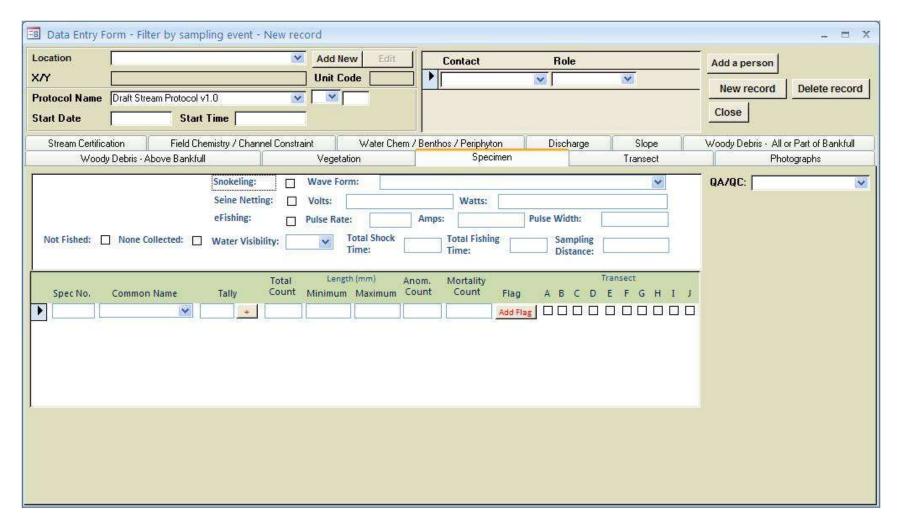
Figure 13. Data entry form for vertebrate Specimens.

24. Click on the Transect tab (Figure 14). You will notice the transect tab has six subtabs. Each subtab needs to be completed before moving on to the next transect. Enter the following fields:
    a. Use the picklist to enter the **transect letter**.
    b. Click on the "Cross Sectional Info" tab and enter the D**istance, Depth, Size Class, and Embed** for the left, left center, center, right center, and right portions of the transect. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    c. Click the Bank Measurement tab and complete the **bank angle** and **undercut distance** fields. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    d. Click the cover tab. Enter the cover code for **filamentous algae, macrophytes, woody debris, brush, live trees and roots, overhanging vines, undercut banks, boulders, and artificial substrate**. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    e. Click the Riparian Estimates tab and enter the left and right bank information for the **Canopy, Understory, and Ground Cover** parameters using the picklist. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    f. Click the Canopy Cover tab and enter the **canopy information**. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    g. Click the Human Influence tab and enter the left and right bank information for each **influence type** listed. If there are any **flags**, enter the flag number and then click the red "Add Flag" button and enter the flag info.
    h. Once complete, click the red "Next Record" button and follow steps a-h. Repeat this process for each transect.
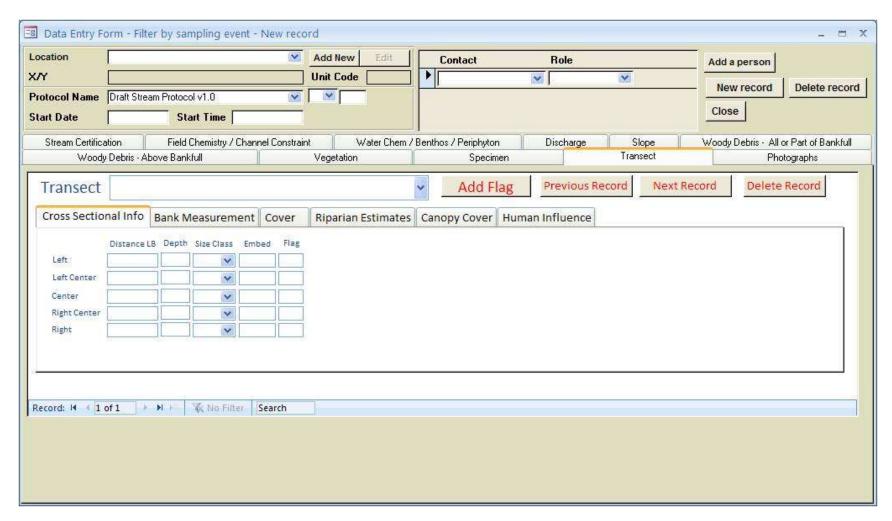
Figure 14. Data entry form for Transect-based physical habitat.

25. Click on the Photograph tab. For each photograph <u>taken at the site</u>, enter the following fields:
    a. Full **name of the photograph**, not including the extension.
    b. Name of the **photographer**.
    c. **Detailed description** of the photograph.
    d. **Date** the photo was taken. (Auto-populates with today's date.)
    e. If this is a really good photograph (something that can be used in reports or web sites) ,check the "**Is this a great photo"** box.
    f. **Photo extension**. (Auto populates with ".jpg.")
    g. Repeat steps a-f for each photograph.
    h. QA/QC: Enter the name of the person who reviewed this record. Note: when possible, the person who entered the record should NOT be the person who QA/QC the record.
    i. At the discretion of the Field Crew Leader, photograph metadata can be recorded on a paper datasheet and entered into a Microsoft Excel spreadsheet at the same time that the photos are downloaded from the camera onto the field laptop. This master Excel spreadsheet can then be imported into the database at the end of the field season.
26. **Data Validation and Verification:** Prior to leaving a site, a field crew member (preferable the one who did not enter the data) should review all the data on the data forms or in the database to make certain they are complete and accurate. Crew members should look for fields that should have been populated but were missed, data values that appear to be extreme, and values that were not included on picklist for individual fields.
27. Once you have finished entering and reviewing the information for the site, click the close button which will bring you to the gateway screen (Figure 5). If you are done entering data, click the **close button** on the gateway screen; this will bring you to the main screen.
28. Insert the flash drive into the tablet computer and wait for the computer to recognize the drive.
29. **Data Backup:** Click the red "**Exit**" button on the database. You will be asked if you want to back up the data, click **Yes**.
30. A browser will open, browse to C:/Stream Monitoring/Data/Database Backup, and save the file using the naming convention the computer automatically provides.
31. The database will now save and close and you are done collecting data for the site. Remove the flash drive and store it in a dry, secure location in a watertight sealable plastic bag.

Data Validation and Verification
In order to ensure the data collected by the KLMN are as accurate as possible, multiple reviews of the data are completed by a variety of staff. Prior to leaving a site, a field crew member (preferable the one who did not enter the data) should review all the data on the data forms or in the database to make certain they are complete and accurate. Crew members should look for fields that should have been populated but were missed, data values that appear to be extreme, and values that were not included on picklist for individual fields.

After surveying each park, it is the responsibility of the Project Lead to review all data collected by the field crew. In addition to looking for errors similar to the ones described above, techniques such as outlier detection and automated data analysis should be done to look for additional errors. This task should be completed prior to releasing field crews from service, so that potential problems can be resolved, if possible.

After the data have gone through the validation and verification process and the data, along with a certified datasheet, have been submitted to the Data Manager, it is the Data Manager's responsibility to conduct an additional review of the data to look for any potential errors missed by the field crew or Project Lead. Once complete and discrepancies addressed, the data are loaded into the master database.